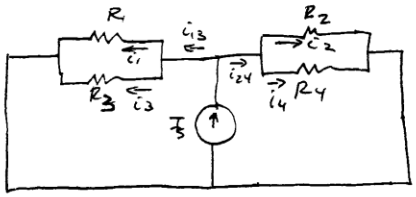
PROBLEM 1:



GIVEN: $R_1 = 10\Omega$, $R_2 = 15\Omega$, $R_3 = 10\Omega$, $R_4 = 30\Omega$, $I_S = 12A$

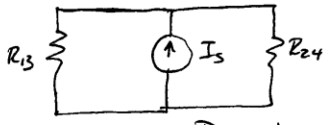
FIND:
- R_{eq}
- $i_{R1}, i_{R2}, i_{R3}, i_{R4}$
- $V_{R1}, V_{R2}, V_{R3}, V_{R4}$
- V_{IS}

$$R_{13} = R_1 // R_3 = \frac{1}{\frac{1}{R_1}+\frac{1}{R_3}} = \frac{1}{\frac{1}{10}+\frac{1}{10}} =$$

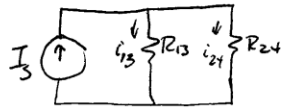
$$R_{13} = 5\Omega$$

$$R_{24} = R_2 // R_4 = \frac{1}{\frac{1}{R_2}+\frac{1}{R_4}} = \frac{1}{\frac{1}{15}+\frac{1}{30}}$$

$$R_{24} = 10\Omega$$



CAN ALSO BE DRAWN



$$R_{eq} = R_{13} // R_{24} = \frac{1}{\frac{1}{R_{13}}+\frac{1}{R_{24}}}$$

$$= \frac{1}{\frac{1}{5}+\frac{1}{10}} = 3.3\overline{3}$$

$$\underline{R_{eq} = 3.3\overline{3}\Omega} \leftarrow$$

SOURCE CURRENT SPLITS BETWEEN R_{13} & R_{24}

$$i_{13} = \frac{\frac{1}{R_{13}}}{\frac{1}{R_{13}}+\frac{1}{R_{24}}} \cdot I_S = \frac{\frac{1}{5}}{\frac{1}{5}+\frac{1}{10}} \cdot 12$$

$$i_{13} = 8A$$

$$i_{24} = \frac{\frac{1}{R_{24}}}{\frac{1}{R_{13}}+\frac{1}{R_{24}}} \cdot I_S = \frac{\frac{1}{10}}{\frac{1}{5}+\frac{1}{10}} \cdot 12$$

$$i_{24} = 4A$$

i_{R13} SPLITS BETWEEN R_1 & R_3

$$i_{R1} = \frac{\frac{1}{R_1}}{\frac{1}{R_1}+\frac{1}{R_3}} \cdot i_{R13} = \frac{\frac{1}{10}}{\frac{1}{10}+\frac{1}{10}} \cdot 8$$

$$\underline{i_{R1} = 4A} \leftarrow$$

$$i_{R3} = \frac{\frac{1}{R_3}}{\frac{1}{R_1}+\frac{1}{R_3}} \cdot i_{R13} = \frac{\frac{1}{10}}{\frac{1}{10}+\frac{1}{10}} \cdot 8$$

$$\underline{i_{R3} = 4A} \leftarrow$$

i_{R24} SPLITS BETWEEN R_2 & R_4

$$i_{R2} = \frac{\frac{1}{R_2}}{\frac{1}{R_2}+\frac{1}{R_4}} \cdot i_{R24} = \frac{\frac{1}{15}}{\frac{1}{15}+\frac{1}{30}} \cdot 4$$

$$\underline{i_{R2} = 2.6\overline{6}A} \leftarrow$$

$$i_{R4} = \frac{\frac{1}{R_4}}{\frac{1}{R_2}+\frac{1}{R_4}} \cdot i_{R24} = \frac{\frac{1}{30}}{\frac{1}{15}+\frac{1}{30}} \cdot 4$$

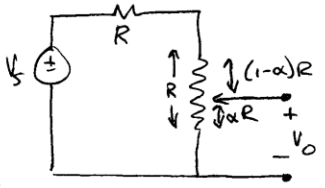
$$\underline{i_{R4} = 1.3\overline{3}A} \leftarrow$$

ALL RESISTORS & SOURCE SHARE THE SAME 2 NODES & THEREFORE ARE IN PARALLEL

$$V_{IS} = V_{R1} = V_{R2} = V_{R3} = V_{R4} = R_{eq} \cdot I_S$$
$$= (3\tfrac{1}{3})(12) = 40V$$

$V_{IS} = 40V$
$V_{R1} = 40V$
$V_{R2} = 40V$
$V_{R3} = 40V$
$V_{R4} = 40V$

PROBLEM 2



GIVEN: CIRCUIT DIAGRAM

FIND:
- THE CURRENT THROUGH EACH ELEMENT IN TERMS OF R, α, V_s
- V_o AS A FUNCTION OF α & V_s
- PLOT V_o AS A FUNCTION OF α AS α VARIES FROM $0 \to 1$.

$R_{eq} = R + R = 2R$

$i = \frac{V_s}{R_{eq}} = \frac{V_s}{2R}$

$\boxed{i = \frac{V_s}{2R}}$ ← NOTE SERIES CIRCUIT SO ALL CURRENTS ARE THE SAME

$V_o = \alpha R \cdot i$

$= \alpha R \cdot \frac{V_s}{2R}$

$\boxed{V_o = \frac{\alpha}{2} \cdot V_s}$

OR USING VOLTAGE DIVISION

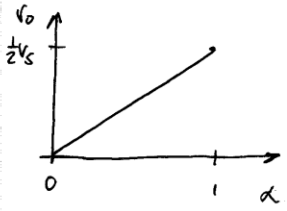
$V_o = \frac{\alpha R}{R + R} \cdot V_s$

$V_o = \frac{\alpha R}{2R} \cdot V_s$

$\boxed{V_o = \frac{\alpha}{2} \cdot V_s}$

IF $\alpha = 0 \Rightarrow V_o = 0$

IF $\alpha = 1 \quad V_o = \frac{1}{2} V_s$



PROBLEM 3

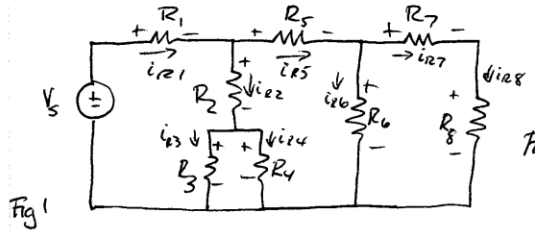


Fig 1

GIVEN: $R_1 = 10\Omega$, $R_2 = 25\Omega$, $R_3 = 60\Omega$, $R_4 = 20\Omega$, $R_5 = 24\Omega$, $R_6 = 20\Omega$, $R_7 = 50\Omega$, $R_8 = 30\Omega$, $V_s = 15V$

FIND:
- VOLTAGE ACROSS EACH RESISTOR
- CURRENT THROUGH EACH RESISTOR
- CURRENT SUPPLIED BY SOURCE

$R_{78} = R_7 + R_8 = 50 + 30 = 80$

$R_{78} = 80\Omega$ ←

$R_{34} = R_3 \| R_4 = \frac{1}{\frac{1}{60} + \frac{1}{20}} = 15$

$R_{34} = 15\Omega$ ←

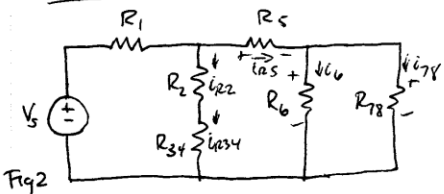


Fig2

$R_{678} = R_6 \| R_{78} = \frac{1}{\frac{1}{R_6} + \frac{1}{R_{78}}} = \frac{1}{\frac{1}{20} + \frac{1}{80}}$

$R_{678} = 16\Omega$ ←

$R_{234} = R_2 + R_{34} = 25 + 15 = 40$

$R_{234} = 40\Omega$ ←

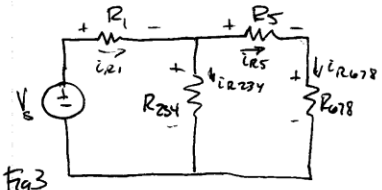


Fig3

$R_{5\to8} = R_5 + R_{678} = 24 + 16$

$R_{5\to8} = 40\Omega$ ←

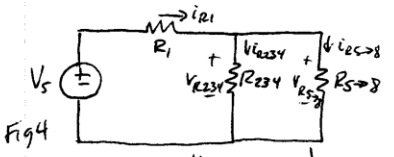


Fig4

$R_{2\to8} = R_{234} \| R_{5\to8} = \frac{1}{\frac{1}{R_{234}} + \frac{1}{R_{5\to8}}} = \frac{1}{\frac{1}{40} + \frac{1}{40}}$

$R_{2\to8} = 20\Omega$ ←

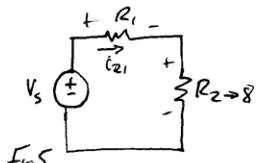


Fig5

$R_{eq} = R_1 + R_{2\to8} = 10 + 20 = 30$

$R_{eq} = 30\Omega$ ←

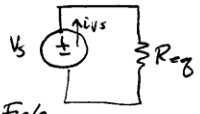


Fig6

$i_{VS} = \frac{V_S}{R_{eq}} = \frac{15}{30}$

$\boxed{i_{VS} = 0.5A}$ ←

FROM Fig 5

$V_{R1} = \frac{R_1}{R_1 + R_{2\to8}} \cdot V_S = \frac{10}{10+20} \cdot 15$

$\boxed{V_{R1} = 5V}$ ←

$V_{R2\to8} = \frac{R_{2\to8}}{R_1 + R_{2\to8}} \cdot V_S = \frac{20}{10+20} \cdot 15$

$V_{R2\to8} = 10V$ ←

$i_{R1} = i_{VS} \Rightarrow \boxed{i_{R1} = 0.5A}$ ←

$i_{R2\to8} = i_{VS} \Rightarrow i_{R2\to8} = 0.5A$ ←

PROBLEM 3 CONT.

From Fig. 4

$V_{R234} = V_{R5\to 8} = V_{R2\to 8} = 10V$

$i_{R234} = \frac{\frac{1}{R_{234}}}{\frac{1}{R_{234}} + \frac{1}{R_{5\to 8}}} \cdot i_{R1}$

$= \frac{\frac{1}{40}}{\frac{1}{40} + \frac{1}{40}} \cdot \overset{0.5}{i_{R1}}$

$i_{R234} = 0.25A \leftarrow$

$i_{R5\to 8} = \frac{\frac{1}{R_{5\to 8}}}{\frac{1}{R_{234}} + \frac{1}{R_{5\to 8}}} \cdot i_{R1}$

$= \frac{\frac{1}{40}}{\frac{1}{40} + \frac{1}{40}} \cdot 0.5$

$i_{R5\to 8} = 0.25A \leftarrow$

From Fig. 3

$i_{R5} = i_{R678} = i_{R5\to 8} = 0.25A$

$\boxed{i_{R5} = 0.25A} \leftarrow$

$i_{R678} = 0.25A \leftarrow$

$V_{R5} = \frac{R_5}{R_5 + R_{678}} \cdot V_{R5678}$

$V_{R5} = \frac{24}{24+16} \cdot 10V$

$\boxed{V_{R5} = 6V} \leftarrow$

$V_{R678} = \frac{R_{678}}{R_5 + R_{678}} \cdot V_{R5678}$

$V_{R678} = \frac{16}{24+16} \cdot 10$

$V_{R678} = 4V \leftarrow$

From Fig. 2

$i_{R2} = i_{R34} = i_{R234} = 0.25A$

$\boxed{i_{R2} = 0.25A} \leftarrow$

$i_{R34} = 0.25A \leftarrow$

$V_{R2} = \frac{R_2}{R_2 + R_{34}} \cdot V_{R234}$

$V_{R2} = \frac{25}{25+15} \cdot 10$

$\boxed{V_{R2} = 6.25V} \leftarrow$

$V_{R34} = \frac{15}{25+15} \cdot 10$

$V_{R34} = 3.75V \leftarrow$

$V_{R6} = V_{R78} = V_{R678} = 4V$

$\boxed{V_{R6} = 4V} \leftarrow$

$V_{R678} = 4V \leftarrow$

$i_{R6} = \frac{\frac{1}{R_6}}{\frac{1}{R_6} + \frac{1}{R_{78}}} \cdot i_{R5} = \frac{\frac{1}{20}}{\frac{1}{20} + \frac{1}{80}} \cdot 0.25$

$\boxed{i_{R6} = 0.2A} \leftarrow$

$i_{R78} = \frac{\frac{1}{R_{78}}}{\frac{1}{R_6} + \frac{1}{R_{78}}} \cdot i_{R5} = \frac{\frac{1}{80}}{\frac{1}{20} + \frac{1}{80}} \cdot 0.25$

$i_{R78} = 0.05A \leftarrow$

PROBLEM 3 CONT.

FROM FIGURE 1

$i_{R7} = i_{R8} = i_{R78}$

$\boxed{i_{R7} = 0.05A}$ ←

$\boxed{i_{R8} = 0.05A}$ ←

$V_{R7} = \frac{R_7}{R_7+R_8} \cdot V_{R78}$

$= \frac{50}{50+30} \cdot 4$

$\boxed{V_{R7} = 2.5V}$ ←

$V_{R8} = \frac{R_8}{R_7+R_8} \cdot V_{R78}$

$= \frac{30}{50+30} \cdot 4$

$\boxed{V_{R8} = 1.5V}$ ←

$V_{R3} = V_{R4} = V_{R34}$

$\boxed{V_{R3} = 3.75V}$ ←

$\boxed{V_{R4} = 3.75V}$ ←

$i_{R3} = \frac{\frac{1}{R_3}}{\frac{1}{R_3}+\frac{1}{R_4}} \cdot i_{R34}$

$i_{R3} = \frac{\frac{1}{60}}{\frac{1}{60}+\frac{1}{20}} \cdot 0.25$

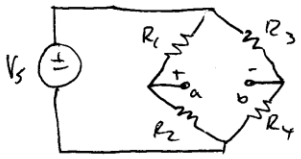
$\boxed{i_{R3} = 0.0625A}$ ←

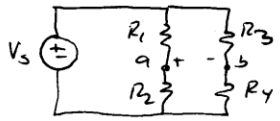
$i_{R4} = \frac{\frac{1}{R_4}}{\frac{1}{R_3}+\frac{1}{R_4}} \cdot i_{R34}$

$= \frac{\frac{1}{20}}{\frac{1}{60}+\frac{1}{20}} \cdot 0.25$

$\boxed{i_{R4} = 0.1875A}$ ←

PROBLEM 4





GIVEN: $V_s = 12V$, $R_1 = 220\Omega$, $R_2 = 220\Omega$
$R_3 = 220\Omega$, $R_4 = 220.05\Omega$

FIND: THE VOLTAGE BETWEEN NODES a & b, V_{ab}

$$V_a = V_{R2} = \frac{R_2}{R_1+R_2} \cdot V_s = \frac{220}{220+220} \cdot 12V$$

$$V_a = 6V$$

$$V_b = V_{R4} = \frac{R_4}{R_3+R_4} \cdot V_s = \frac{220.05}{220+220.05} \cdot 12V$$

$$V_b = 6.00068V$$

$$V_{ab} = V_a - V_b = (6 - 6.00068)V$$

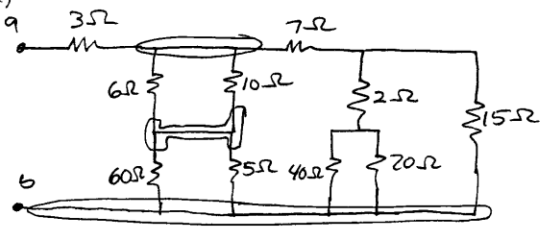
$V_{ab} = -0.00068\,V$ ←

$V_{ab} = -0.68\,mV$

EE301/303 SP10 HW# 2b Solutions 7/11

PROBLEM 5

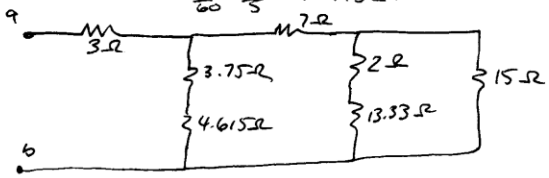
Part a)



$20\Omega // 40\Omega = \frac{1}{\frac{1}{20}+\frac{1}{40}} = 13\frac{1}{3}\Omega$

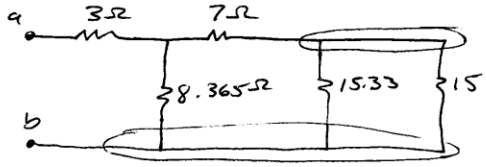
$6\Omega // 10\Omega = \frac{1}{\frac{1}{6}+\frac{1}{10}} = 3.75\Omega$

$60 // 15\Omega = \frac{1}{\frac{1}{60}+\frac{1}{5}} = 4.615\Omega$

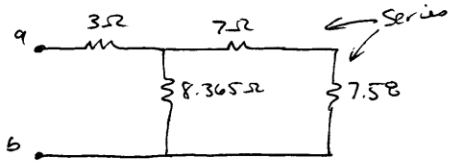


$3.75 + 4.615 = 8.365$

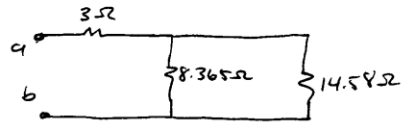
$2 + 13.33 = 15.33$



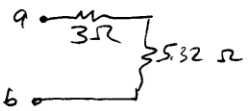
$15 // 15.33 = \frac{1}{\frac{1}{15}+\frac{1}{15.33}} = 7.58\Omega$



$7 + 7.58 = 14.58\Omega$



$8.365 // 14.58 = \frac{1}{\frac{1}{8.365}+\frac{1}{14.58}} = 5.32\Omega$

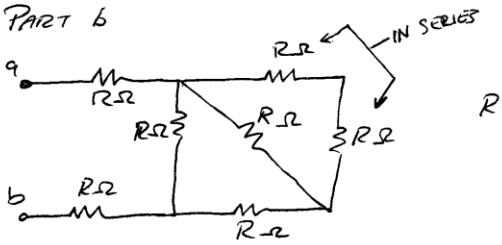


$R_{ab} = 3 + 5.32$

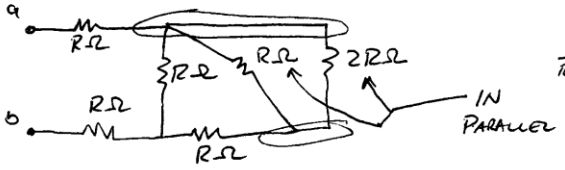
$R_{ab} = 8.32\Omega$ ←

PROBLEM 5 CONT.

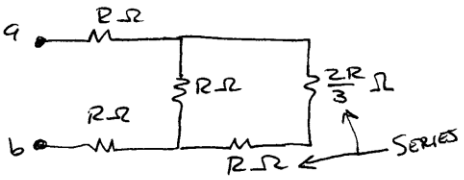
PART b



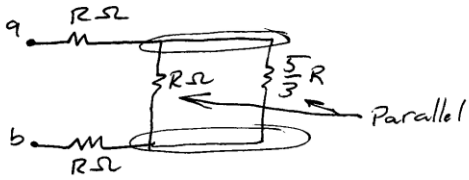
$R+R = 2R\,\Omega$



$$\frac{1}{\frac{1}{R}+\frac{1}{2R}} = \frac{1}{\frac{2}{2R}+\frac{1}{2R}} = \frac{1}{\frac{3}{2R}} = \frac{2R}{3}$$

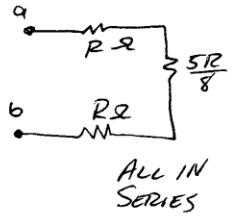


$$R+\frac{2}{3}R = \frac{3}{3}R+\frac{2}{3}R = \frac{5}{3}R$$



$$\frac{1}{\frac{1}{R}+\frac{1}{\frac{5R}{3}}} = \frac{1}{\frac{1}{R}+\frac{3}{5R}} = \frac{1}{\frac{5}{5R}+\frac{3}{5R}}$$

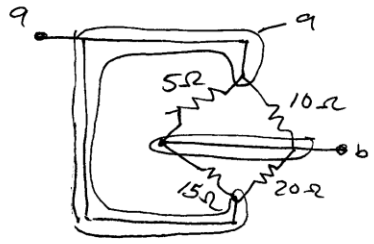
$$= \frac{1}{\frac{8}{5R}} = \frac{5R}{8}$$



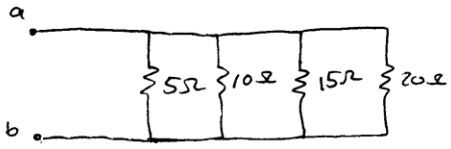
$$R_{eq} = R+\frac{5R}{8}+R = \frac{8}{8}R+\frac{5R}{8}+\frac{8}{8}R$$

$$\boxed{R_{eq} = \frac{21}{8}R}$$

PROBLEMS
PART C



WILL HELP TO REDRAW



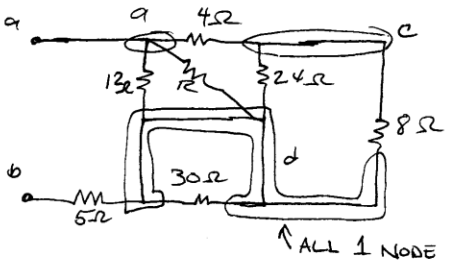
$$R_{ab} = \frac{1}{\frac{1}{5}+\frac{1}{10}+\frac{1}{15}+\frac{1}{20}} = 2.4\,\Omega = R_{ab} \leftarrow$$

$$= \frac{12}{5}\,\Omega = R_{AB} \leftarrow \text{OR.}$$

EE301/303 SP10 HW #6

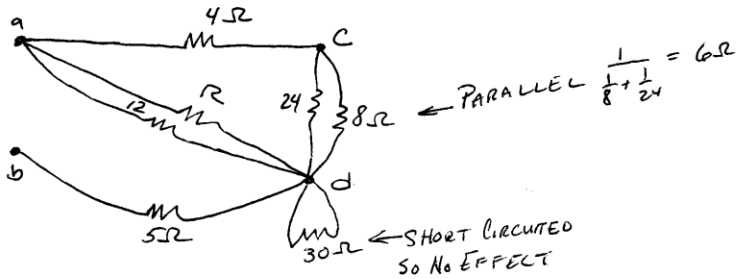
PROBLEM 5

PART d.



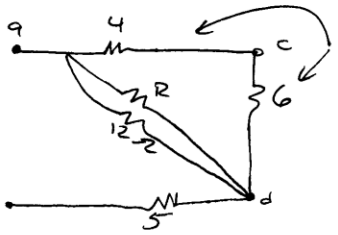
FIND R SUCH THAT THE EQUIVALENT RESISTANCE BETWEEN a & b IS 9Ω

MAY HELP TO REDRAW

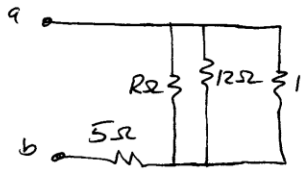


← PARALLEL $\frac{1}{\frac{1}{8}+\frac{1}{24}} = 6\Omega$

← SHORT CIRCUITED SO NO EFFECT



SERIES 4+6 = 10Ω



← Parallel $\frac{1}{\frac{1}{R}+\frac{1}{12}+\frac{1}{10}} = \frac{1}{\frac{60}{60R}+\frac{5R}{60R}+\frac{6R}{60R}}$

$R_{par} = \frac{60R}{60+11R}$

$R_{ab} = 5 + \frac{60R}{60+11R} = 9$

PROBLEM 5 part d CONT.

$$R_{ab} = 5 + \frac{60R}{60+11R} = 9$$

$$\frac{60R}{60+11R} = 4$$

$$60R = 4(60+11R)$$

$$60R = 240 + 44R$$

$$16R = 240$$

$$R = \frac{240}{16}$$

$$\underline{R = 15\Omega} \Leftarrow$$